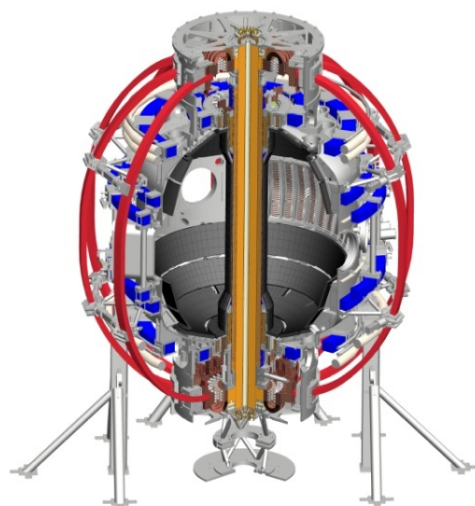


Research Operations Update

S.P. Gerhardt


**August 2015 NSTX-U Team Meeting
PPPL
8/14/2015**

Coll of Wm & Mary
 Columbia U
 CompX
 General Atomics
 FIU
 INL
 Johns Hopkins U
 LANL
 LLNL
 Lodestar
 MIT
 Lehigh U
 Nova Photonics
 ORNL
 PPPL
 Princeton U
 Purdue U
 SNL
 Think Tank, Inc.
 UC Davis
 UC Irvine
 UCLA
 UCSD
 U Colorado
 U Illinois
 U Maryland
 U Rochester
 U Tennessee
 U Tulsa
 U Washington
 U Wisconsin
 X Science LLC



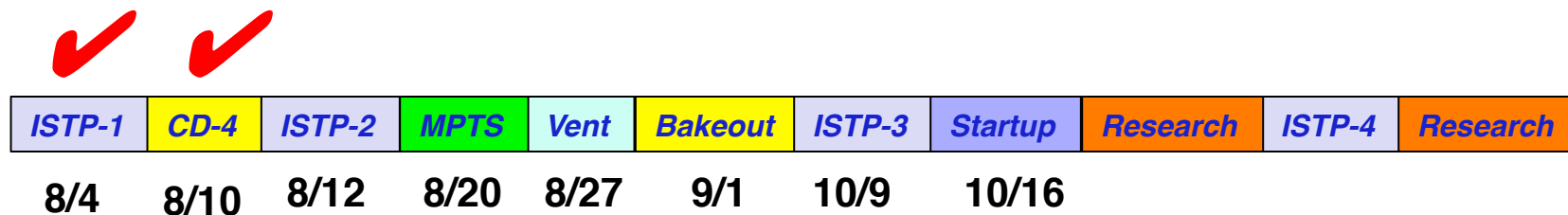
Culham Sci Ctr
 York U
 Chubu U
 Fukui U
 Hiroshima U
 Hyogo U
 Kyoto U
 Kyushu U
 Kyushu Tokai U
 NIFS
 Niigata U
 U Tokyo
 JAEA
 Inst for Nucl Res, Kiev
 Ioffe Inst
 TRINITI
 Chonbuk Natl U
 NFRI
 KAIST
 POSTECH
 Seoul Natl U
 ASIPP
 CIEMAT
 FOM Inst DIFFER
 ENEA, Frascati
 CEA, Cadarache
 IPP, Jülich
 IPP, Garching
 ASCR, Czech Rep

Outline

- Near Term Schedule 
- Diagnostic Operations
- RF Operations
- Physics Operations
- Boundary Physics Operations

Landscape (+Goal) For the Near Term Schedule

- ISTP-1: Pre-CD-4 ✓
 - Goal: Prepare for CD-4
- CD-4 ✓
- ISTP-2: Post CD-4, Before Bakeout
 - Do remaining coils for magnetics calibrations
- MPTS Rayleigh-Raman Scattering
- Small Vent...see talk by Al.
- Bakeout
- ISTP-3: Post Bakeout, Before Run
 - Prepare for Commissioning/Startup Phase
- Commissioning/Startup Phase
- Research Ops
- ISTP-4
 - Increase to full fields for research phase
- Full Research Operations

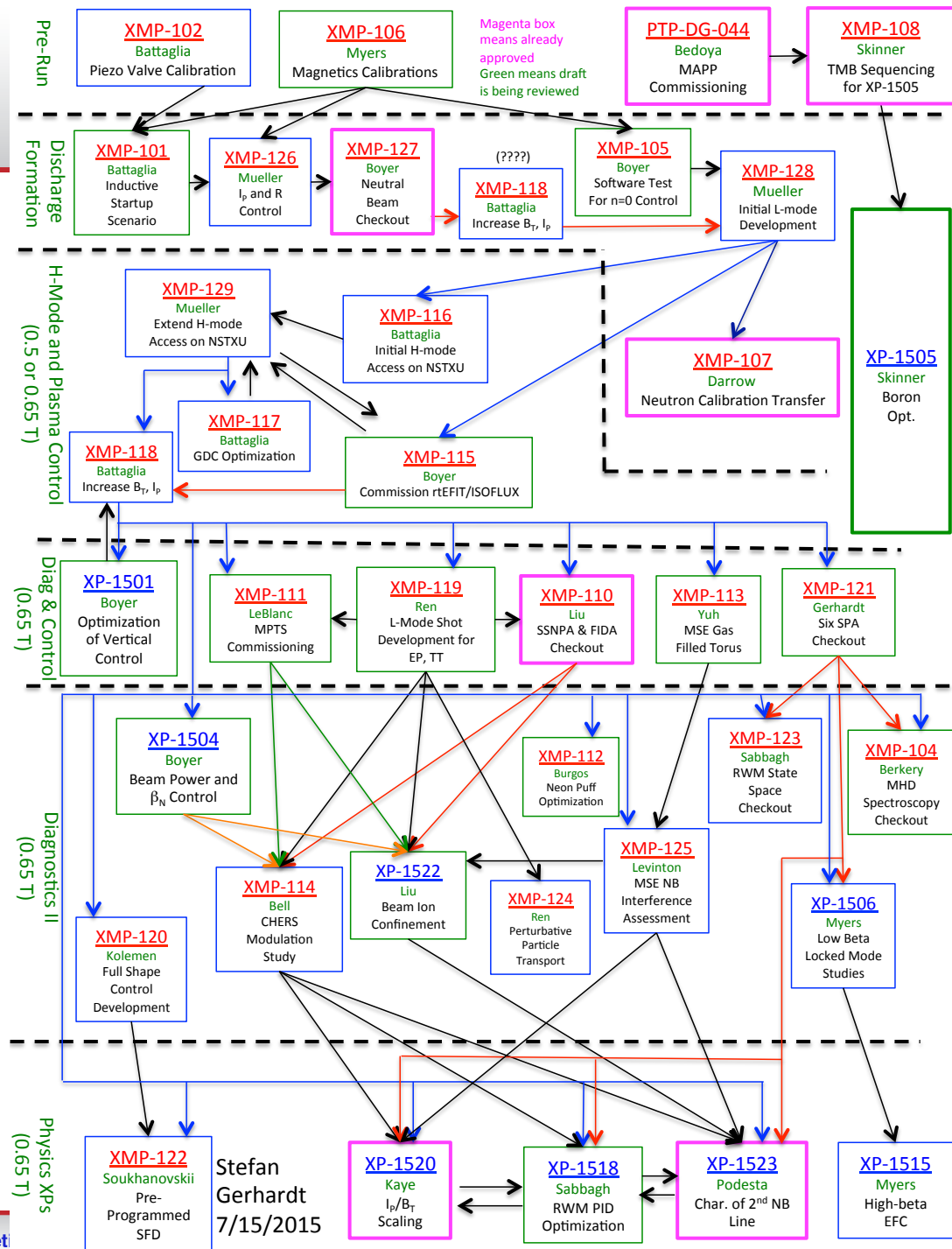


But I Still Need to Work on My Diagnostic!


- There will be few-day blocks of time before and after especially following bakeout.
 - Presently around September 2nd and October 1st...but subject to change!!!
 - Check the rollover schedule.
- There will be second shift access other times, but essentially no access during the bakeout.
 - Hot He, NBI commissioning.
- Best bet is to coordinate through Brent, Bob Ellis, Al von Halle.
- Get the work permits, or full procedures for large jobs, in the system as soon as possible.

Linkages For the Startup Phase Have Been Established

If you want to see this in detail, let me know and I will send you a copy.



Outline

- Near Term Schedule
- Diagnostic Operations 
- RF Operations
- Physics Operations
- Boundary Physics Operations

Lots of Progress on Magnetic Diagnostics

- Plasma current, loop voltage, poloidal flux and field measurements in good shape.
 - Many more B-probes in the divertor regions than before.
 - First round of pickup compensations used for CD-4 activities
 - Data collected in ISTP-001 phase 2 and XMP-106 will help prepare for the run and correct CD-4 data.
- New diamagnetic loop system is showing promise.
 - Based on using the I_p rogowski return leads as a diamagnetic loop and a new rogowski on the TF coil to subtract out the direct TF pickup.
 - If successful, then eliminates the old TF-coil diamagnetic system.
- High-n array acquisition is installed and functioning.
 - Need to install the breakout box.
- RWM sensors are the final frontier.

Highlights of Diagnostic Progress

Page 1


- MPTS in final stages of preparation for Rayleigh-Raman scattering.
 - MPTS collected data during XMP-131!
- Vacuum interface hardware and stand for divertor SPRED have been fabricated.
- Divertor Imaging Radiometer is ready for installation.
 - But instrument will likely go on Bay I midplane initially.
- Mounting bracket for SAMI receiver has been built.
- BES fibers are loaded into new holders and stored in wood boxes, ready to move to NSTX-U Test Cell and install.
- MAPP probe is installed and pumped down.

Highlights of Diagnostic Progress

Page 2

- XEUS, LoWEUS and MONA LISA spectrometers are installed on their stand. Vacuum pumping manifold is being designed.
- Upgraded DTI is ready for installation in upcoming small vent.
- Mounting bracket and magnetic shield for Bay “H” top infrared camera have been built.
- Mounting bracket for Bay “G” bottom IR camera has been built.
- A successful FDR for the Fusion Products diagnostic has been held.
- The stand for the LGI has been designed. Fabrication will take place next week.


Outline

- Near Term Schedule
- Diagnostic Operations
- RF Operations 
- Physics Operations
- Boundary Physics Operations

ECH-PI and HHFW Update

- ECH-Pre Ionization system commissioned and supported CD4
- HHFW sources #3 - #6 commissioned and ready for supporting operations
 - Sources #1 and #2 almost ready
- Decoupling between sources for vacuum operation adjusted to better than -30 db down
 - Will begin vacuum conditioning of HHFW antennas soon (starting with sources #3 - #6)
- ORNL reflectometer installed and being instrumented for measuring density fluctuations and PDI effects through the HHFW antenna
- ORNL Langmuir probe being modified to fit through a gate valve to make measurements in front of the antenna
- 6 coaxial Langmuir probe arrays at J Top and J Bottom being instrumented for measuring RF deposition properties associated with the RF power lost to the SOL
- RF probes are being prepared for Bay J installation
- Several IR cameras are installed and will provide wide angle RF coverage for viewing the RF deposition in the divertor regions bottom and top
- Mounting equipment and DAQ are being built for the antenna-dedicated fast visible camera and IR camera

Outline

- Near Term Schedule
- Diagnostic Operations
- RF Operations
- Physics Operations 
- Boundary Physics Operations

PCS Update

- Lots of PCS success during CD-4 and ISTP activities
 - Pre-programmed PF control
 - Gas injection and pre-fill control
 - Pre-programmed TF and OH control
 - Realtime magnetic sensor calibrations
 - Background testing of vertical control code
- Near term PCS steps
 - Finish implementation of vertical control and beam control algorithms.
 - Finish testing rtEFIT and flux-projection boundary control algorithm.
 - Replace the legacy Merlin digitizers with SAD II units.
 - Restore SPA and RWM control capability
- Then move on to profile control and snowflake divertor control, other code improvements,...

Physics Operators Course is in Progress

- First lectures from 7/21 to 7/30
 - Camp, Davis, Gates, Mueller, Raman, Stevenson, Que
 - Talks available [here](#).
- Next lectures from 9/15-9/22
 - DCPS, EFIT, magnetics, gas injection, PCS hardware, test cell grounding, HHFW, control theory.
- Entire team is welcome to attend
- For those intending to become an actual physics operator, need to:
 - Complete course
 - Read a few additional procedures
 - On-the-job-training when we run again
 - Document all three in training records
 - Dennis will help with this step.

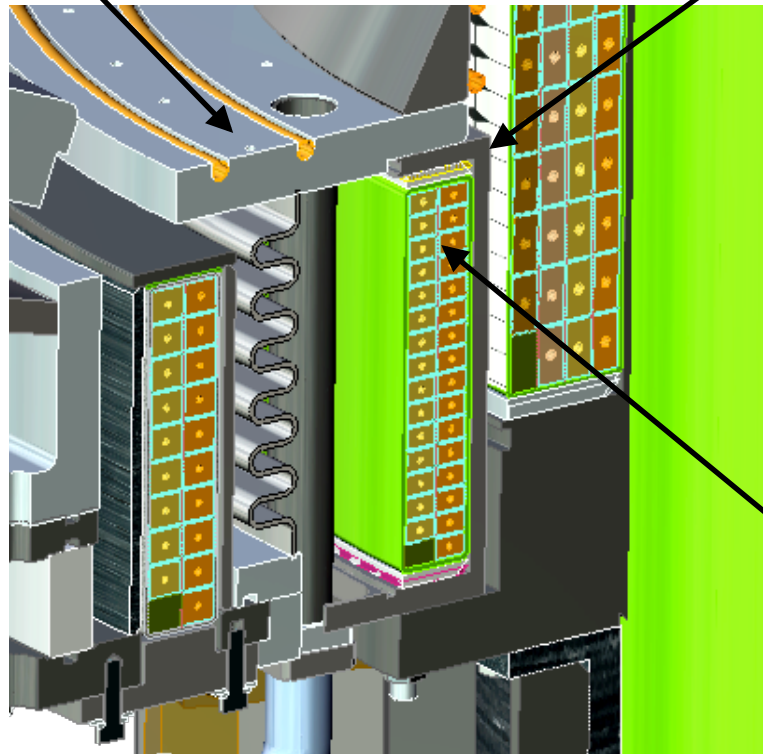
Outline

- Near Term Schedule
- Diagnostic Operations
- RF Operations
- Physics Operations
- Boundary Physics Operations ←

PF-1b Coils Present Interesting Opportunities for Engineering Optimization During Bakeout

We want it hot here...350 C if possible
(Where the tiles are)

We want to avoid thermal gradients here
(Where there is a small stitch weld holding the casing to the PF-1b mandrel)

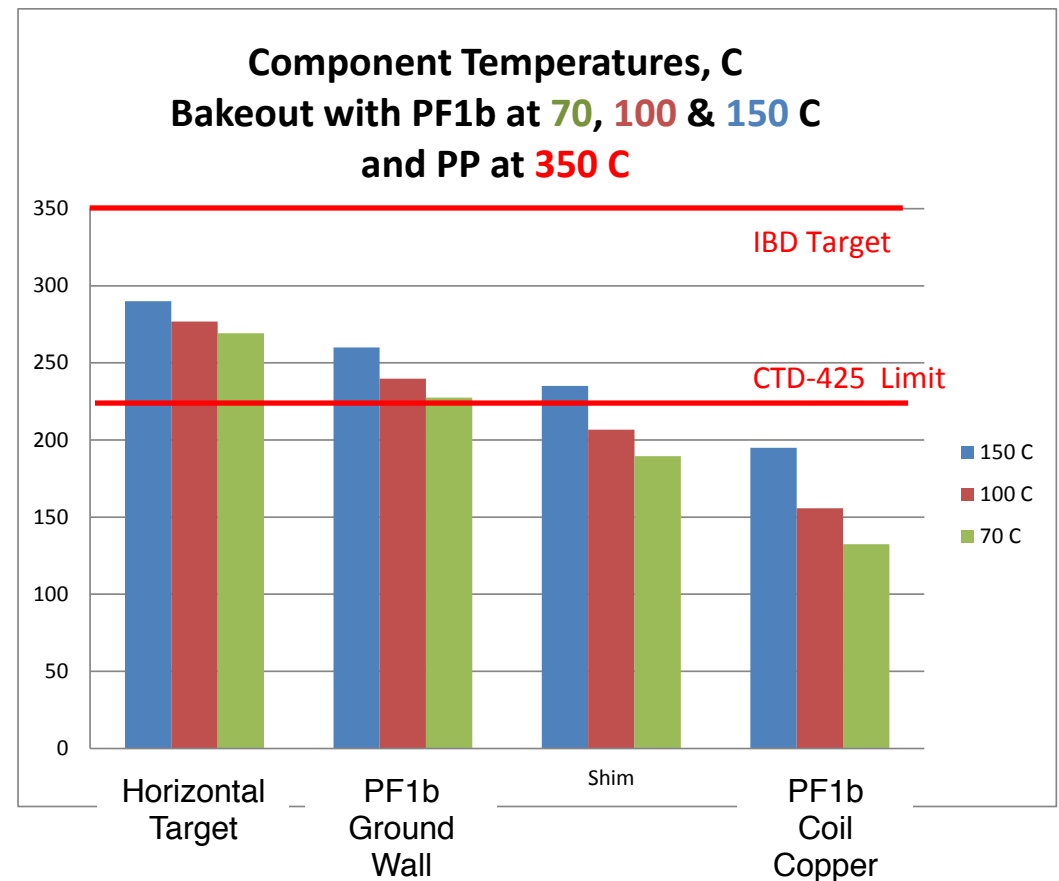


We want it cool here
(On the coil turn-and-ground-insulation)

Flowing 70 C Water Through PF-1b Appears to be the Optimal Compromise

- Options for control are limited:
 - Flowing hot helium on copper cooling tubes was infeasible.
- Optimal solution appears to be 70 C water in PF-1b
 - Keeps insulation below 225 limit.
 - Limits weld stress
 - Allows the horizontal target to reach ~270 C.
- Heat exchanger solution being implemented to provide correct water to the PF-1b during next bakeout.

Temperature at Four Locations as a Function of the PF-1b Water Temperature

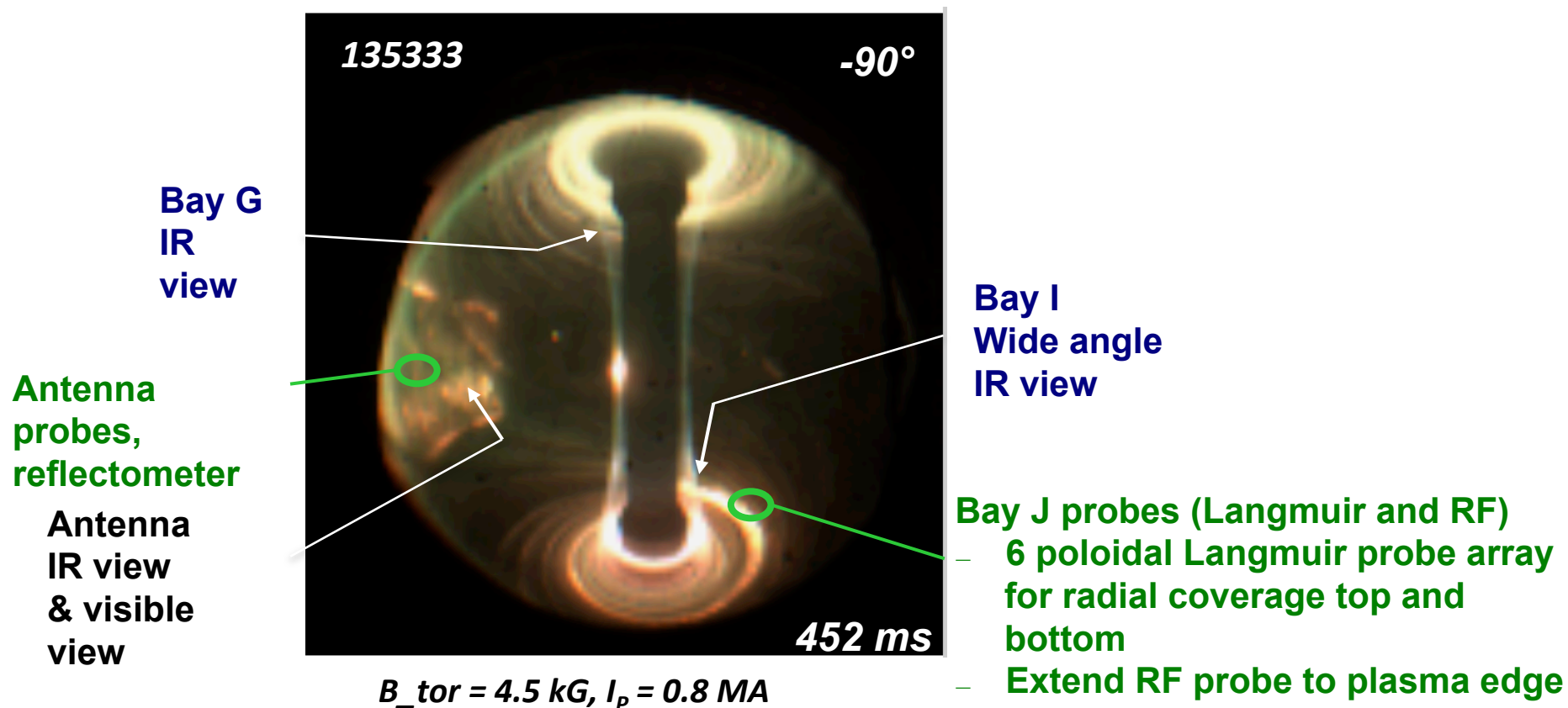


Note on the Bakeout

- If your diagnostic has special cooling needs, you should have already communicated this to Atiba.
- But if you didn't, do so now!

The End!

IR camera and probe upgrade: critical for documenting RF edge heating



- Diagnostics configured: to “see” hot HHFW streak over wide range of field pitch
- IR views: at bottom, top and antenna
- Probes for measuring IV characteristics and RF fields: Coaxial Langmuir and RF probe

Scope For Upcoming Vent

- Install “Argon Dump System” TIVs.
 - Will enable later installation of the Argon dump system.
- Install Divertor Tangential Imaging (DTI)
- Replace Bay B shutter
- Install a window at Bay J upper
- Do test insertions for LITER and MAPP probes
- Assess any interferences at Bay L for the fusion products detector.
- Potentially clean any windows that are severely compromised.

If you need something done and it is not on this list, then you are late...but talk to Brent or Al.